FIGURE 1

PRIOR ART

PRIOR ART
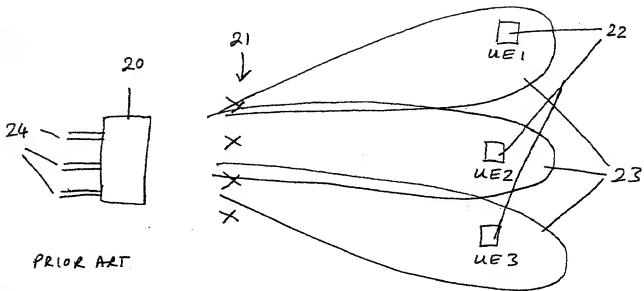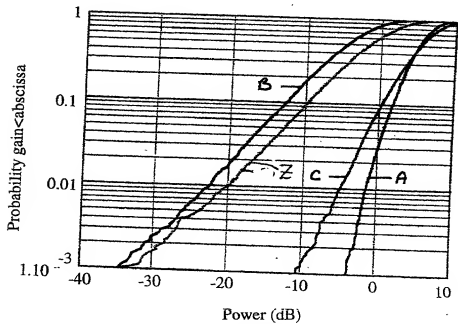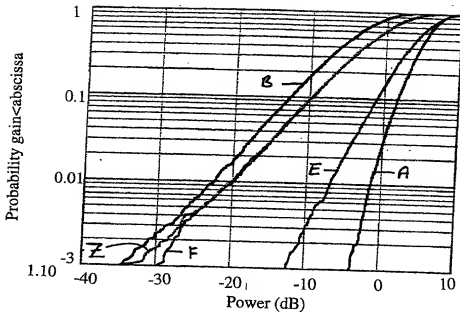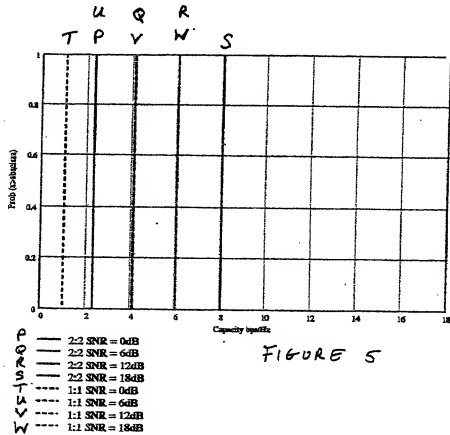
FIGURE 2

Figure 3

A Max channel, no correlation
B Min channel, no correlation
C Max channel, complete correlation
D Min channel, complete correlation (not present)
Z Baseline 1:1

A Max channel, polarisation diversity, full polarisation conversion
B Min channel, polarisation diversity, full polarisation conversion
E Max channel, pol'n diversity, no polarisation conversion
F Min channel, pol'n diversity, no polarisation conversion
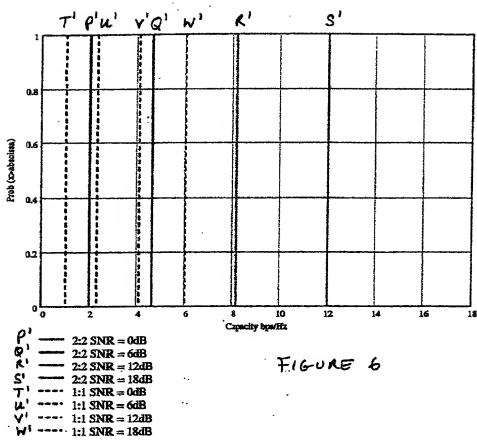Z Baseline 1:1

Figure 4

P —— 2:2 SNR = 0dB
Q —— 2:2 SNR = 6dB
R —— 2:2 SNR = 12dB
S —— 2:2 SNR = 18dB
T ---- 1:1 SNR = 0dB
U ---- 1:1 SNR = 6dB
V ---- 1:1 SNR = 12dB
W ---- 1:1 SNR = 18dB

FIGURE 5

FIGURE 6

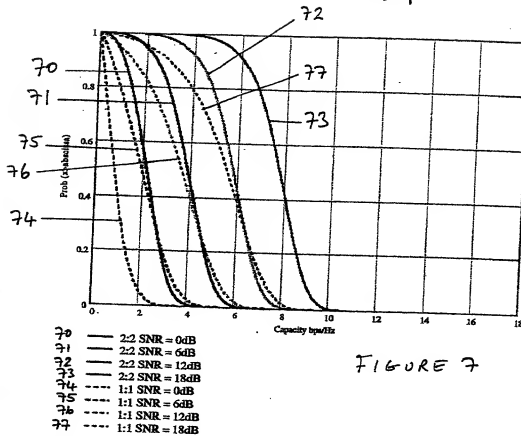| Symbol		Description
P'	——	2:2 SNR = 0dB
Q'	——	2:2 SNR = 6dB
R'	——	2:2 SNR = 12dB
S'	——	2:2 SNR = 18dB
T'	-----	1:1 SNR = 0dB
u'	-----	1:1 SNR = 6dB
V'	-----	1:1 SNR = 12dB
W'	-----	1:1 SNR = 18dB

Figure 7 – Capacity for 2:2 space diversity MIMO system with the basestation antennas (transmitter) completely correlated and the mobile completely uncorrelated.
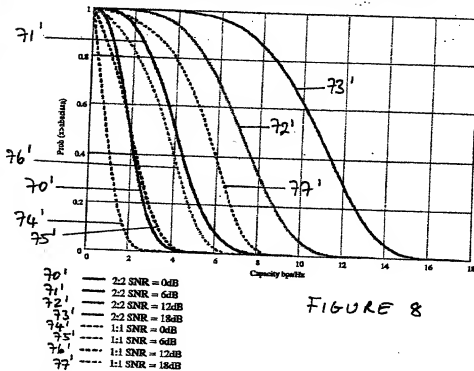

Figure 8 – Capacity for 2:2 polarisation diversity MIMO with no polarisation conversion in the environment

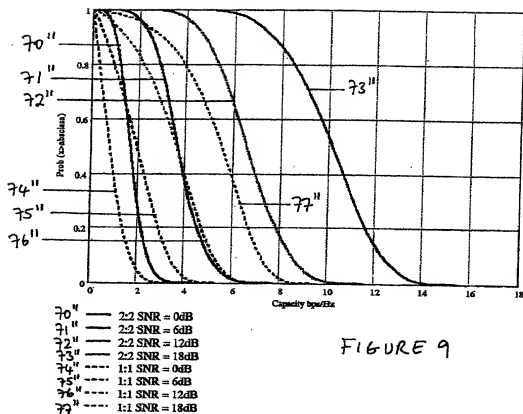70" ─── 2:2 SNR = 0dB
71" ─── 2:2 SNR = 6dB
72" ─── 2:2 SNR = 12dB
73" ─── 2:2 SNR = 18dB
74" --- 1:1 SNR = 0dB
75" --- 1:1 SNR = 6dB
76" --- 1:1 SNR = 12dB
77" --- 1:1 SNR = 18dB

FIGURE 9

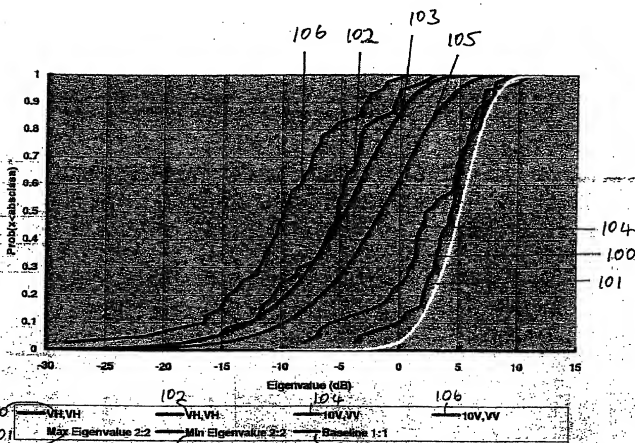| 100 | VH,VH | | 102 | | 104 | 10V,VV | | 106 | 10V,VH |
| 101 | Max Eigenvalue 2:2 | | | Min Eigenvalue 2:2 | | Baseline 1:1 | | | |

Figure 0-10.—Measured distributions for the power gains for the orthogonal MIMO paths for 2:2 space and polarisation diversity configurations.
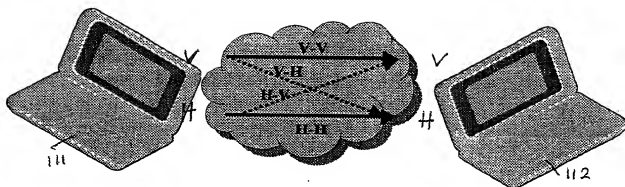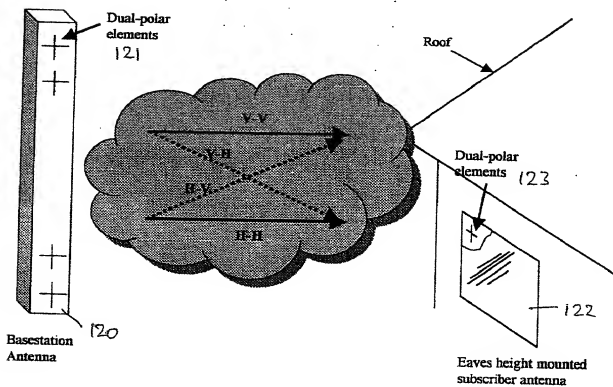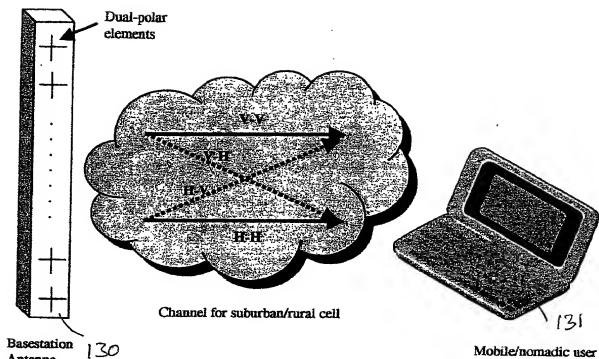
FIGURE 10.

FIGURE 11

FIGURE 12

Dual-polar elements

V-V

V-H

H-V

H-H

Channel for suburban/rural cell

Basestation Antenna 130

Mobile/nomadic user 131

FIGURE 13

Ceiling mounted dual polar basestation antenna 140

V-V

V-H

H-H

H-V

141

Separate wireless modem attached to PC (also, could be integrated), with integral dual-polar antenna. 142

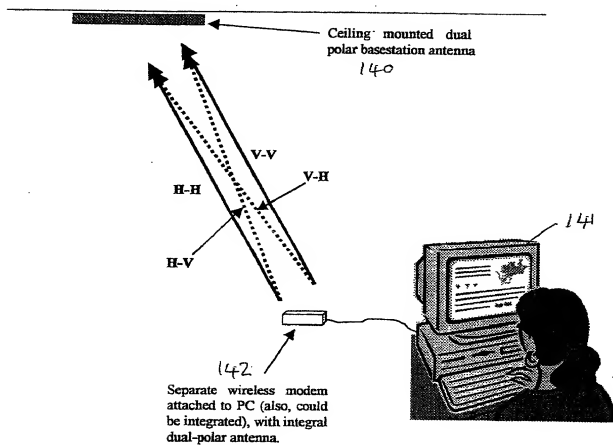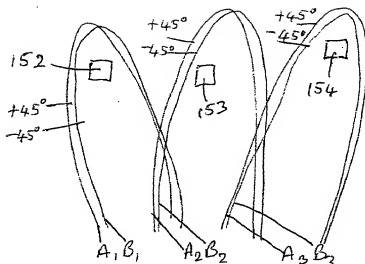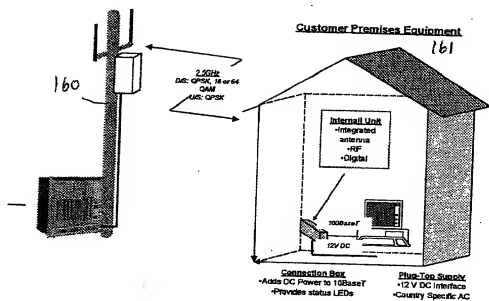FIGURE 14

Fig 15 A

Fig 15 B

FIGURE 16

170

BTS RF Architecture
(Single channel - 3 beams/sector)

3 beams/sector with RF
beamformer and 2-branch Tx
MIMO – with soft redundancy
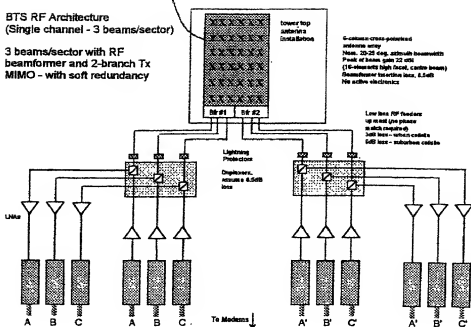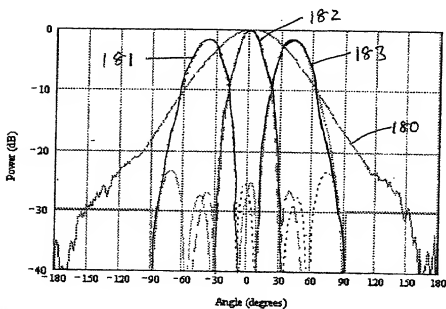
tower top
antenna
installation

8-column cross-polarised
antenna array
Nom. 20-25 deg. azimuth beamwidth
Peak of beam gain 22 dBi
(16-elements high /vert. centre beam)
Beamformer tx mtrx loss, 6.5dB
No active electronics

bfr #1   bfr #2

Low loss RF feeders
Up to std (no phase
match required)
3dB loss - when cabin is
6dB loss - suburban cabin

Lightning
Protection

Digitisers.
assume < 6.5dB
loss

LNAs

A   B   C   A   B   C .   A'   B'   C'   A'   B'   C'

To Modems

FIGURE 17

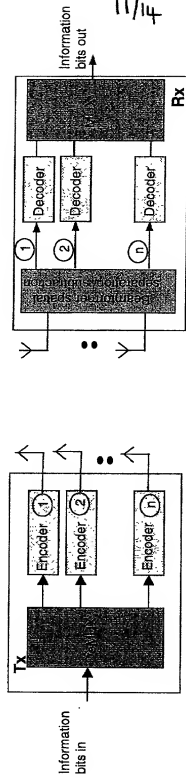FIGURE 18.

Basic Space-Time Coding Techniques

Space-Time Block Coding (STBC)
• defined for 3G
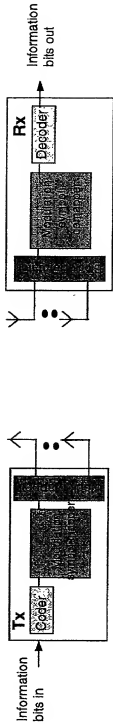
Layered Space-Time Coding (BLAST)
• more applicable to fixed/nomadic

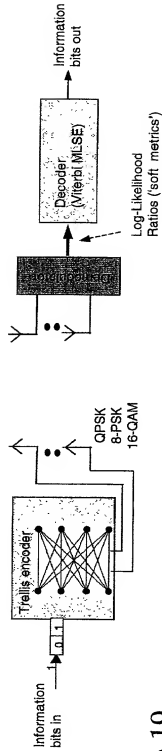**Space-Time Trellis Coding (STTC)**
• suitable for both mobile and fixed
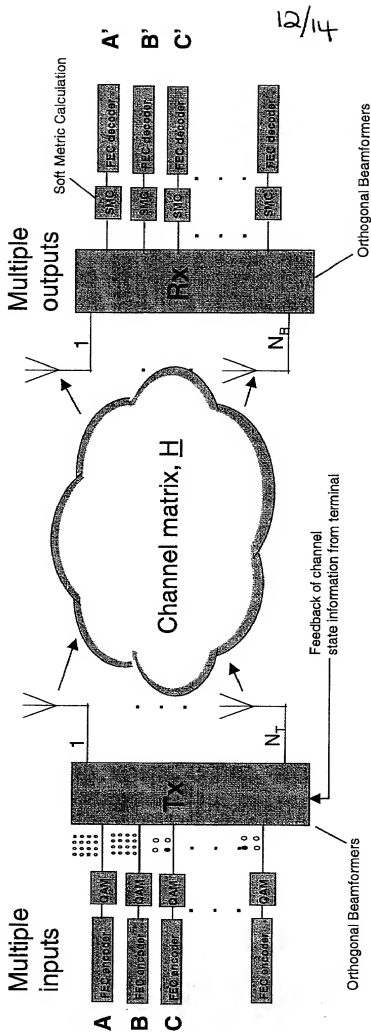
Figure 19

Feedback STC - Separated Subchannels

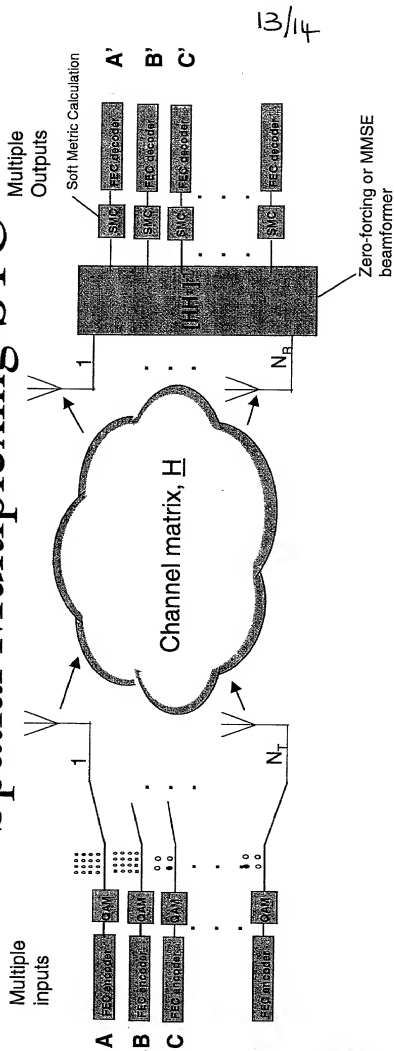

Figure 20

Spatial Multiplexing STC

Figure 21
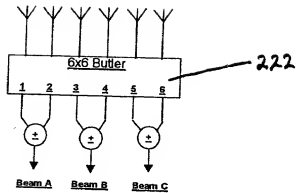
FIGURE 22